

THE PREVALENCE AND RISK FACTORS OF MUSCULOSKELETAL DISORDERS IN THE HANDS OF FISHERMEN WORKING AS OYSTER SHUCKERS

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Abstract

Objectives: This study aimed to investigate the prevalence of musculoskeletal disorders in the hands and wrists of fishermen working as oyster shuckers, and to identify the risk factors associated with oyster shucking. **Material and Methods:** A total of 590 fishery workers including those working as oyster shuckers in 2015–2017 were included in the study analysis. Hand osteoarthritis (OA), carpal tunnel syndrome (CTS), and ulnar impaction syndrome were diagnosed using X-ray, magnetic resonance imaging, and physical examinations according to each diagnostic criterion. The Rapid Entire Body Assessment was used as a measurement tool for analyzing the occupation-related burden factors. **Results:** The prevalence of hand OA, CTS, and ulnar impaction syndrome was higher in oyster shuckers than in aquaculture/offshore fishery workers. The prevalence of upper limb disease was higher in oyster shuckers than in other fishery workers, even in the prevalence of exposure to occupational burden factors. In oyster shuckers, the incidence of hand and wrist OA was 84%, that of CTS was 72%, and that of ulnar impaction syndrome was 41%. In addition, oyster shuckers were more likely to be exposed to occupational burden factors than were other types of fishermen. **Conclusions:** The prevalence of hand OA, CTS, and ulnar impaction syndrome was higher in oyster shuckers. Therefore, proper stretching or exercises for rest and musculoskeletal relaxation, along with health-care education and promotion, will be needed for the fishermen's repeated posture and impact work. *Int J Occup Med Environ Health.* 2021;34(5):603–15

Key words:

osteoarthritis, fishermen, musculoskeletal disorders, wrist, hands, oyster shuckers

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INTRODUCTION

Oyster farming is one of the major aquaculture fisheries in the south coast of Korea, especially in Tongyeong, and it forms an important part of the local economy. In addition, Korea is one of the world's leading producers of oysters, producing 300 000 tons of oysters and 40 000 tons of oysters without shells each year [1] (Figure 1). Therefore, oyster shucking, which involves removing oyster shells during oyster harvesting, is an important fishing occupation, with 22 000 employees and a relatively high annual profit of over 20 million per person [1]. Given the nature of oyster shucking, however, repeated and persistent hand and wrist burdens are given in a long and constant position, and the proportion of women is too high, resulting in the musculoskeletal disorders of the hand and wrist. However, few studies have been reported [2]. In addition, working in an unnatural position for an extended period of time can place strain on the workers' hips or shoulder joints. Hsu et al. [2] reported that Taiwanese oyster shuckers' work caused discomfort or pain in the order of prevalence of the back, hand, wrist, shoulder, and elbow joints. However, there have been no reports on the analysis of various musculoskeletal disorders in the hands and wrists, or studies of the relationship between musculoskeletal disorders and oyster shucking.



Figure 1. An aerial photo of the Tongyeong's Oyster Farm, Republic of Korea

Therefore, the purpose of this study was to investigate the prevalence of musculoskeletal disorders in the hands and wrists of fishermen working as oyster shuckers, and to identify risk factors associated with oyster shucking.

MATERIAL AND METHODS

Participants

In the period of October 2015–August 2017, the subjects visited Gyeongsang National University Hospital in person to receive a survey and a detailed examination. In 2015, the criteria for selecting the subjects were to have 190 participants who were working as oyster strippers in the Hadong area. The selection criteria for 2016 were to have 250 fishermen who worked in aquaculture or as offshore fishery workers living in Hadong, Sacheon, and Gimhae. The criteria for selection in 2017 were to establish the fishermen's control groups in 2015 and 2016, and targeted 150 office workers who had lived in Gyeongnam for >10 years. Finally, a total of 590 subjects from 2015–2017 were included in the study analysis.

Health examination survey

The one-on-one survey was conducted by nurses who were informed on the objective of this study and who were trained in data collection procedures. The survey included information on socio-demographic variables (age, gender, education, type of fishery, fishery period).

Diagnosis of hand osteoarthritis

The inclusion criteria for the diagnosis of hand and wrist osteoarthritis (OA) were:

- pain or tenderness of the finger joint and thumb basal joints;
- the radiologic presence of joint space narrowing, subchondral sclerosis, and marked osteophytes;
- the presence of Heberden's node or Bouchard's node, or deformity of the finger joint;
- a loss of the range of motion of fingers joints.

The exclusion criteria of hand OA were:

- a history of inflammatory arthritis such as rheumatoid arthritis;
- any abnormal findings, such as an old fracture or previous surgery, in radiographs [3].

Diagnosis of carpal tunnel syndrome

The inclusion criteria for the diagnosis of carpal tunnel syndrome (CTS) were:

- symptoms including sensory abnormalities or pain in the median nerve region, radiating pain in the proximal wrist, night cry or thenar atrophy;
- positive findings of a provocation test, such as Phalen's test, Tinel's sign, and a direct compression test. When both the symptoms and the physical examination showed positive results, the case where the final confirmation was done by an electromyography test was defined as CTS.

The exclusion criteria were:

- a history of previous surgery around the wrist;
- negative finding of an electromyography test, even if the patients had the symptoms or physical examination suggesting CTS [4].

Diagnosis of ulnar impaction syndrome

The inclusion criteria for the diagnosis of ulnar impaction syndrome were:

- 1) a history of ulnar side wrist pain, aggravated rotation, and ulnar deviation of the wrist during wrist rotation or squeezing objects, or difficulty in holding or lifting objects;
- 2) positive findings such as tenderness around the ulnar styloid process (the fovea sign), an ulnocarpal stress test, and an ulnocarpal grind test;
- 3) radiographic finding of ulnar positive variance or neutral variance in the PA wrist view;
- 4) degenerative findings of triangular fibrocartilage complex (TFCC) in magnetic resonance imaging (MRI).

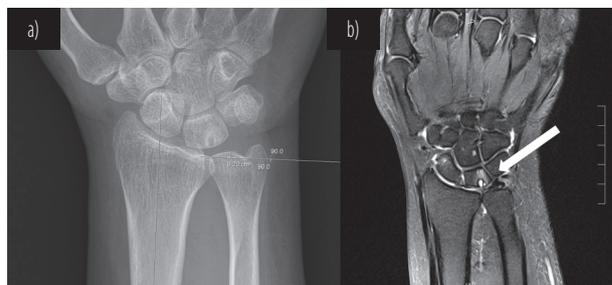


Figure 2. Radiographic findings of ulnar impaction syndrome in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea: a) X-ray, b) magnetic resonance imaging (white arrow: bone marrow edema of lunate bone)

Finally, ulnar impaction syndrome was diagnosed when (1) was always present, and (2), (3) and (4) had occurred at least once [5].

The exclusion criteria were:

- a history of trauma or surgery around the wrist;
- a radiologic finding of advanced OA of the distal radioulnar joint;
- a history of inflammatory arthritis, such as rheumatoid arthritis, gouty arthritis, and infectious arthritis;
- the presence of an abnormality of the carpal bone, such as Kienbock's disease, scaphoid nonunion, or carpal instability (Figure 2).

Evaluation method for exposure to burden work

Type of fishery (oyster shucking, aquaculture/offshore fishery)

The participants in this study were recruited by classifying them into occupations by oyster shucking in 2015 and aquaculture/offshore fishery in 2016. As a control group in 2017, office workers were recruited and analyzed. During the 3-year recruitment period, subjects from different occupations were enrolled to analyze the differences in the disease prevalence by type of fishery.

Occupation-related burden factors

Repetitive or improper postures and tasks that exert pressure on the hand have been classified as major risk factors

for hand or wrist musculoskeletal disorders. For having these risk factors, the authors set the risk to increase when there were additional factors such as shock or vibration. Otherwise, it was judged that the burden level was low. The 4 factors for occupation-related burden were classified as follows:

- Factor 1 – when the wrist motion is repeated every few seconds or the wrist posture is bad;
- Factor 2 – work that requires continuous force on the finger (fixture: ≥ 0.9 kg) or wrist (grip force: ≥ 4.5 kg);
- Factor 3 – work exposed to local vibration, such as the operation of a mower or a cultivator;
- Factor 4 – work that uses the back of the hand like a hammer (>20 times/day).

Statistical analysis

In the descriptive analysis, the authors analyzed categorical variables using a χ^2 test or Fisher's exact test, and continuous variables by a t-test or 1-way ANOVA.

For the multiple regression analysis, the authors found that factors 1 and 2 were always $>50\%$, while factors 3 and 4 were often 25–50%, which increased the workload. Repetition/attitude/force (factor 1 + factor 2) was defined as always $\geq 50\%$ in factor 1 (repeat/posture), and at the same time always $\geq 50\%$ in factor 2 (force). Vibration (factor 3) or shock (factor 4) was defined as when either vibration or shock was frequently 25–50%.

Risk exposure levels were categorized based on repetition/posture/force, and were classified as having a burden level lower than this or having an additional burden level. In addition to this classification, risk exposure levels were classified by calculating the sums of the 4 workload factors. The authors carried out statistical analyses using SPSS for Windows software, v. 22.0 (SPSS, Chicago, IL, USA) and software R, v. 3.1.0 (The R 100 Foundation, Vienna, Austria), with $p < 0.05$ considered significant.

RESULTS

Baseline characteristics of the participants

A total of 590 subjects were analyzed. The percentage of females was higher in both oyster shuckers (females: 85.8% vs. males: 14.2%, $p < 0.001$) and office jobs (females: 66.8% vs. males: 34.0%, $p < 0.001$). In oyster shuckers (aged ≥ 60 years: 71.1% vs. <60 years: 28.9%, $p < 0.001$) and office workers (aged >60 years: 59.3% vs. <60 years: 40.7%, $p < 0.001$), the proportion of people aged >60 years was high, and the ratio of those aged <60 years was high in aquaculture/offshore fishery workers (>60 years: 48.8% vs. <60 years: 51.2%, $p < 0.001$) with high work intensity. For obesity, there were statistically significantly higher rates in oyster shuckers (44.2%) and aquaculture/offshore fishery workers (40.8%) than among office workers (28.0%, $p = 0.006$).

The percentage of work experience of >30 years was statistically significantly higher for office workers (57.3%) than for oyster shuckers (37.4%) and aquaculture/offshore fishery workers (39.6%, $p < 0.001$). The baseline characteristics of the participants are summarized in Table 1.

Occupational burden factors and levels

Analyzing the exposure of the 4 occupational burden factors, in all factors the frequency of exposure to $>50\%$ of the burden factors was statistically significantly higher for oyster shuckers than for aquaculture, offshore fishery workers or office workers (Table 2).

In the workload level analysis, the proportion of burden factors, such as work repetition, posture, force, vibration, and shock, was statistically significantly higher for oyster shuckers (21.1%) than for aquaculture/offshore fishery workers (9.2%) or office workers (0%) ($p < 0.001$) (Table 3).

Prevalence of hand OA, CTS, and ulnar impaction syndrome

The prevalence of females was significantly higher than that of males in hand OA ($p < 0.001$), CTS ($p = 0.003$), and ulnar

Table 1. General characteristics of fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea

Variable	Participants (N = 590)				P
	oyster shuckers (N = 190)	aquaculture/offshore fishery workers (N = 250)	office workers (N = 150)	total	
Sex [n (%)]					<0.001
male	27 (14.2)	127 (50.8)	51 (34.0)	205 (34.7)	
female	163 (85.8)	123 (49.2)	99 (66.0)	385 (65.3)	
Age [n (%)]					<0.001
<60 years	55 (28.9)	128 (51.2)	61 (40.7)	244 (41.4)	
60–69 years	71 (37.4)	107 (42.8)	60 (40.0)	238 (40.3)	
≥70 years	64 (33.7)	15 (6.0)	29 (19.3)	108 (18.3)	
Age (M±SD)	61.8±8.1	64.9±9.0	59.5±6.5	61.9±8.2	
Obesity [n (%)]					0.006
normal	106 (55.8)	148 (59.2)	108 (72.0)	362 (61.4)	
obesity	84 (44.2)	102 (40.8)	42 (28.0)	228 (38.6)	
Education [n (%)]					<0.001
elementary school	151 (79.5)	105 (42.0)	0 (0.0)	256 (43.4)	
middle school	24 (12.6)	81 (32.4)	8 (5.3)	113 (19.2)	
high school	15 (7.9)	64 (25.6)	142 (94.7)	221 (37.5)	
Insurance [n (%)]					0.042
health insurance	181 (95.3)	246 (98.4)	150 (100.0)	577 (97.8)	
potential poverty	3 (1.6)	1 (0.4)	0 (0.0)	4 (0.7)	
medical care	6 (3.2)	3 (1.2)	0 (0.0)	9 (1.5)	
Fishery period* [n (%)]					<0.001
<10 years	38 (20.0)	37 (14.8)	13 (8.7)	88 (14.9)	
10–19 years	52 (27.4)	39 (15.6)	21 (14.0)	112 (19.0)	
20–29 years	29 (15.3)	75 (30.0)	30 (20.0)	134 (22.7)	
≥30 years	71 (37.4)	99 (39.6)	86 (57.3)	256 (43.4)	

* The control group (office workers) was defined as performing office work (teachers, public officials).

impaction syndrome ($p < 0.001$). In addition, the prevalence of OA ($p < 0.001$) and ulnar impaction syndrome ($p < 0.001$) increased to a statistically significant degree with increasing age. Carpal tunnel syndrome was significantly higher in obese patients (67.1%, $p < 0.001$). Hand OA ($p < 0.001$),

CTS ($p < 0.001$), and ulnar impaction syndrome ($p < 0.001$) showed a higher prevalence among junior high-school graduates or those younger than high-school graduates.

Fishing experience did not show any statistical significance for the 3 diseases. In terms of fishery occupations, however,

Table 2. The occupational burden factor exposure in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea

Factor	Participants (N = 590)								p
	oyster shuckers (N = 190)		aquaculture/ offshore fishery workers (N = 250)		office workers (N = 150)		total		
	n	%	n	%	n	%	n	%	
Factor 1. When the wrist motion is repeated every few seconds or the wrist posture is bad									<0.001
almost none	1	0.5	11	4.4	22	14.7	34	5.8	
rare (<25%)	11	5.8	33	13.2	40	26.7	84	14.2	
often (25–50%)	22	11.6	57	22.8	34	22.7	113	19.2	
always (>50%)	156	82.1	149	59.6	54	36.0	359	60.8	
Factor 2. Work that requires continuous force on the finger (fixture: ≥0.9 kg) or wrist (grip force: ≥4.5 kg)									<0.001
almost none	3	1.6	16	6.4	121	80.7	140	23.7	
rare (<25%)	26	13.7	39	15.6	22	14.7	87	14.7	
often (25–50%)	32	16.8	68	27.2	5	3.3	105	17.8	
always (>50%)	129	67.9	127	50.8	2	1.3	258	43.7	
Factor 3. Work exposed to local vibration such as the operation of a mower or a cultivator									<0.001
almost none	177	93.2	181	72.4	145	96.7	503	85.3	
rare (<25%)	8	4.2	34	13.6	4	2.7	46	7.8	
often (25–50%)	5	2.6	14	5.6	1	0.7	20	3.4	
always (>50%)	0	0.0	21	8.4	0	0.0	21	3.6	
Factor 4. Work that uses the back of your hand like a hammer to affect (>20 times/day)									<0.001
almost none	104	54.7	194	77.6	142	94.7	440	74.6	
rare (<25%)	31	16.3	38	15.2	8	5.3	77	13.1	
often (25–50%)	29	15.3	13	5.2	0	0.0	42	7.1	
always (>50%)	26	13.7	5	2	0	0.0	31	5.3	

oyster shuckers showed a statistically significantly higher prevalence in the 3 diseases (hand OA: 84.2%; CTS: 71.6%; ulnar impaction syndrome: 41.1%) compared to office workers and

aquaculture/offshore fishery workers. In addition, the higher the workload and the number, the statistically significantly higher prevalence was observed in all 3 diseases (Table 4).

Table 3. The work burden level and the number of work burden in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea

Variable	Participants (N = 590)								P
	oyster shuckers (N = 190)		aquaculture/ offshore fishery workers (N = 250)		office workers (N = 150)		total		
	n	%	n	%	n	%	n	%	
Work burden level									
low	63	33.2	143	57.2	149	99.3	355	60.2	<0.001
repetition/posture/power	87	45.8	84	33.6	1	0.7	172	29.2	
repetition/posture/power + vibration/impact	40	21.1	23	9.2	0	0.0	63	10.7	
Work burden number									
low	28	14.7	73	29.2	94	62.7	195	33.1	<0.001
1 kind	24	12.6	58	23.2	55	36.7	137	23.2	
2 kinds	97	51.1	93	37.2	1	0.7	191	32.4	
3–4 kinds	41	21.6	26	10.4	0	0.0	67	11.4	

Table 4. Prevalence of upper limb disease by major factors in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea

Variable	Participants (N = 590)							
	total	with hand OA (N = 448, 75.9%)		with CTS (N = 340, 57.6%)		with ulnar impaction syndrome (N = 96, 16.3%)		
		n	%	n	%	n	%	
Sex								
male	205	129	62.9	101	49.3	13	6.3	
female	385	319	82.9	239	62.1	83	21.6	
Age								
<60 years	224	160	71.4	132	58.9	23	10.3	
60–69 years	238	187	78.6	148	62.2	38	16.0	
≥70 years	108	101	93.5	60	55.6	35	32.4	
Obesity								
normal	362	282	77.9	187	51.7	59	16.3	
obesity	228	166	72.8	153	67.1	37	16.2	
Education								
elementary school	256	221	86.3	182	71.1	73	28.5	
middle school	113	79	69.9	72	63.7	7	6.2	
high school	221	148	67.0	86	38.9	16	7.2	

Table 4. Prevalence of upper limb disease by major factors in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea – cont.

Variable	Participants (N = 590)						
	total	with hand OA (N = 448, 75.9%)		with CTS (N = 340, 57.6%)		with ulnar impaction syndrome (N = 96, 16.3%)	
		n	%	n	%	n	%
Insurance							
health insurance	577	441	76.4	333	57.7	95	16.5
potential poverty	4	1	25.0	2	50.0	0	0.0
medical care	9	6	66.7	5	55.6	1	11.1
Fishery period							
<10 years	88	67	76.1	53	60.2	15	17.0
10–19 years	112	84	75.0	66	58.9	28	25.0
20–29 years	134	98	73.1	79	59.0	10	7.5
≥30 years	256	199	77.7	142	55.5	43	16.8
Occupation (survey year)							
office worker (2017)	150	113	75.3	38	25.3	13	8.7
aquaculture/offshore fishery worker (2016)	250	175	70.0	166	66.4	5	2.0
oyster shucker (2015)	190	160	84.2	136	71.6	78	41.1
Work burden level							
low	355	255	71.8	164	46.2	46	13.0
repetition/posture/power	172	137	79.7	125	72.7	33	19.2
repetition/posture/power + vibration/impact	63	56	88.9	51	81.0	17	27.0
Work burden number							
low	195	146	74.9	83	42.6	19	9.7
1 kind	137	94	68.6	65	47.4	18	13.1
2 kinds	191	148	77.5	139	72.8	42	22.0
3–4 kinds	67	60	89.6	53	79.1	18	26.9

CTS – carpal tunnel syndrome; OA – osteoarthritis.

Multivariate logistic regression analysis of the relationship between the occupational burden factor, exposure levels and upper extremity musculoskeletal disorders

Hand OA

Gender and age were statistically significant risk factors in all 3 models ($p < 0.05$). However, the duration of fishing was not statistically significant. The occupational burden

level was significantly related in model 1 ($p < 0.05$), and the number of occupational burdens was significant in model 2 ($p < 0.05$). However, no statistical significance was observed according to occupation (Table 5).

CTS

Age was not statistically significant in any of the 3 models. However, all the 3 models ($p < 0.05$) showed a statistically

Table 5. Multivariate logistic regression analysis of the relationship between occupational burden factors, exposure levels and hand osteoarthritis (OA) in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea

Variable	Multivariate logistic regression																	
	hand OA			CTS			ulnar impaction syndrome											
	model 1	model 2	model 3	model 1	model 2	model 3	model 1	model 2	model 3	model 1	model 2	model 3						
Sex	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
male	1	1	1	1	1	1	1	1	1	1	1	1						
female	2.92	1.93–4.41	3.05	2.01–4.62	2.92	1.89–4.49	1.66	1.15–2.39	1.69	1.17–2.44	1.97	1.32–2.96	3.74	1.99–7.01	3.77	2.00–7.11	1.81	0.90–3.64
Age	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
<60 years	1	1	1	1	1	1	1	1	1	1	1	1						
60–69	1.85	1.19–2.89	1.91	1.23–2.97	1.99	1.28–3.08	1.24	0.83–1.85	1.25	0.84–1.87	1.50	0.99–2.28	1.76	0.98–3.19	0.73	0.96–3.13	1.64	0.87–3.10
≥70 years	7.22	3.15–16.52	7.38	3.22–16.93	7.22	3.10–16.80	0.94	0.58–1.54	0.97	0.59–1.59	1.10	0.64–1.89	4.19	2.25–7.82	4.31	2.29–8.09	2.14	1.08–4.23
Obesity	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
normal	1	1	1	1	1	1	1	1	1	1	1	1						
obesity	0.74	0.49–1.12	0.77	0.51–1.16	0.77	0.51–1.16	1.84	1.28–2.65	1.81	1.25–2.61	1.70	1.17–2.48	0.95	0.58–1.54	0.87	0.53–1.43	0.86	0.50–1.46
Fishery period	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
<10 years	1	1	1	1	1	1	1	1	1	1	1	1						
10–19 years	0.92	0.46–1.88	0.93	0.46–1.89	0.97	0.48–1.97	0.91	0.49–1.69	0.90	0.49–1.68	1.02	0.55–1.91	1.68	0.79–3.56	1.68	0.79–3.58	1.85	0.83–4.13
20–29 years	1.13	0.57–2.21	1.12	0.57–2.20	1.17	0.60–2.29	1.09	0.60–1.97	1.11	0.61–2.01	1.26	0.69–2.32	0.48	0.20–1.17	0.48	0.19–1.17	0.74	0.29–1.92
≥30 years	1.26	0.68–2.32	1.23	0.67–2.28	1.28	0.69–2.37	0.97	0.57–1.64	0.94	0.55–1.59	1.27	0.74–2.19	1.07	0.54–2.12	1.08	0.54–2.14	1.41	0.67–2.96
Work burden level	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
low	1	1	1	1	1	1	1	1	1	1	1	1						
repetition/posture/power	1.40	0.88–2.23			2.94	1.96–4.40			1.45	0.86–2.45								
Work burden level – cont.	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
repetition/posture/power + vibration/impact	2.85	1.21–6.71			4.59	2.34–9.02			2.23	1.12–4.42								
Work burden number	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI						
low	1	1	1	1	1	1	1	1	1	1	1	1						
1 kind	0.68	0.41–1.16			1.08	0.69–1.69			1.51	0.73–3.12								
2 kinds	1.03	0.62–1.70			3.25	2.10–5.03			2.51	1.34–4.72								
≥ 3 kinds	2.65	1.09–6.42			4.58	2.35–8.92			3.46	1.59–7.53								

Table 5. Multivariate logistic regression analysis of the relationship between occupational burden factors, exposure levels and hand osteoarthritis (OA) in fishery workers including oyster shuckers taking part in the analysis, October 2015–August 2017, Gyeongsang National University Hospital, Republic of Korea – cont.

Variable	Multivariate logistic regression											
	hand OA			CTS			ulnar impaction syndrome					
	model 1	model 2	model 3	model 1	model 2	model 3	model 1	model 2	model 3			
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI		
Occupation (survey year)												
office worker (2017)	1		1		1		1		1		1	
aquaculture/offshore fishery worker (2016)	1.28	0.70–2.34	6.78	4.06–11.34	6.78	4.06–11.34	0.29	0.10–0.85	0.29	0.10–0.85	0.29	0.10–0.85
oyster shucker (2015)	1.12	0.68–1.85	6.75	4.14–11.00	6.75	4.14–11.00	6.56	3.37–12.80	6.56	3.37–12.80	6.56	3.37–12.80

Abbreviations as in Table 4.

Model 1 – sex, age, obesity, fishery period, work burden level; model 2 – sex, age, obesity, fishery period, number of work burden; model 3 – sex, age, obesity, fishery period, occupation (survey year).

significant high prevalence both for women and obesity. The duration of fishing was not statistically significant. The occupational burden level was significant in model 1 ($p < 0.05$), and the number of job burdens was significantly related in model 2 ($p < 0.05$). No statistical significance was observed according to occupation.

Ulnar impaction syndrome

There were no statistically significant differences in sex and age in all the 3 models, and the duration of fishing was not statistically significant. The occupational burden level was significant in model 1 ($p < 0.05$), and the number of job burdens was significantly related in model 2 ($p < 0.05$). Oyster shuckers had a higher risk of ulnar impaction syndrome than did office workers. However, the risk of ulnar impaction syndrome was lower in aquaculture/offshore fishery workers than in office workers.

DISCUSSION

The main findings of this study were that the prevalence of hand OA, CTS, and ulnar impaction syndrome was higher in oyster strippers than in aquaculture/offshore fishery workers. In oyster shuckers, the prevalence of hand OA was 84%, that of CTS was 72%, and that of ulnar impaction syndrome was 41%. The prevalence of upper limb disease was higher in oyster shuckers than in other fishery workers, even in the prevalence of exposure to occupational burden factors.

Baseline characteristics of the participants (sex and age)

All fishers as well as office workers had a high prevalence of hand OA, probably because of the high average age of the subjects included in the study. In addition, unlike other regions, because of the aging of the population and the lack of work force, Gyeongsangnam-do has a high age rate and fisheries experience. For this reason, the incidence of work-related hand diseases seems to result from the burden of fishing work.

Previous studies have reported that being older is the most important risk factor of hand OA among women [6]. The study group also had a large proportion of the elderly and women, and both the risk and prevalence of hand OA were high.

Occupational burden factors and exposure levels

According to the existing epidemiological studies, the risk factor alone does not significantly increase the risk of musculoskeletal disorders, but the risk increases when ≥ 2 factors are present at the same time [7]. In addition, it was difficult to assess the effect of individual risk factors, because the distribution of the burden factors tended to be biased to one side among the subjects included in this study. In this study, therefore, the most basic hand-bearing task, a repetitive or improper posture, while simultaneously applying power, was classified as a basic risk factor for wrist and hand musculoskeletal disorders.

In this study, the movement of the hand during oyster shucker's work, a "dart throw motion" [8], occurred repeatedly in the hands holding the knife with ulnar deviation + volar flexion and radial deviation + dorsiflexion. On the other hand, the non-working hand holding the oyster experienced repeated flexion and extension of the wrist while holding the oyster (Figure 3).



Figure 3. The movement of the hand during oyster shucker's work, a "dart throw motion" occurred repeatedly in the hands holding the knife with a) ulnar deviation + volar flexion and b) radial deviation + dorsiflexion. On the other hand, the non-working hand holding the oyster experienced repeated c) flexion and d) extension of the wrist while holding the oyster

Theoretically, the hand where the knife operation is done may increase loading on the scaphotrapeziotrapezoid joint around the TFCC and the scaphoid, and may be vulnerable to OA occurrence while the knife is grasped and loaded on both thumb basal joints [9]. In addition, since the hand holding the oyster needs to hold it for a long time and maintain the bending position of the wrist, the risk of developing a hand disease is expected to increase as loading is applied to the pisohamate joint and TFCC, which are flexor carpi ularis insertions.

Prevalence of hand OA, CTS, and ulnocarpal impaction syndrome

Hand OA

Similar to other epidemiology studies for hand or wrist OA, gender and age were the major risk factors [6,10]. However, in this study, the age increase in the occupation of oyster shuckers was not a risk factor for hand OA, probably because arthritis is a degenerative disease of the hand that progresses gradually over a long period of time, and the average age of the study subjects was ≥ 60 years. In this study, the prevalence of hand OA was 75.9%, most of which would have been advanced. As the population density in cities is accelerating, often only the elderly population remains in the fishing area. Therefore, in the future, hand OA will be an important health concern for oyster shuckers, with there being more and more elderly female workers.

Because the wrist and the hand are joints not related to weight load, obesity was not a risk factor. In addition, the risk of increasing the burden of complex exposure was caused by the workload factor. However, there was no statistically significant difference between the fishery period and the type of occupation.

CTS

Incidence rates of $\leq 276/100\ 000$ population per year have been reported, with a prevalence rate of $\leq 9.2\%$ in

women and 6% in men [11]. In the present study, CTS was not related to age. However, as in previous epidemiological studies, the prevalence of CTS was higher for both women and obesity. In addition, it showed a very clear relationship with the workload, but the duration of fishing was not related.

Ulnar impaction syndrome

Ulnar impaction syndrome is a disease affecting the wrist joints, such as hand arthritis, which can be caused by a positive variation of the ulna or external factors such as the posture of ulnar deviation [12]. In this study, gender and age were clearly related, and obesity was not significantly related. Moreover, the duration of the fishery period was not relevant.

The burden of work was relatively clearly related. The typical pain-generating movements in patients with ulnar impaction syndrome are movements in everyday life, such as turning the bottle cap, opening the door, squeezing the mop, or turning a gas range [13]. In the present study, oyster shuckers had a higher risk of ulnar impaction syndrome than did white-collar workers, but for aquaculture/offshore fishery workers, the risk of ulnocarpal impaction syndrome was lower than that for white-collar workers, probably because of the difference in the posture of ulnar deviation according to occupation.

There were several limitations of this study. First, it used a cross-sectional study design. During the 3-year recruitment period, selection bias could have occurred in the study by recruiting subjects from different occupations. Second, the evaluation of the workload was conducted through a questionnaire.

Nevertheless, this study examined the prevalence of hand and wrist diseases diagnosed through objective examinations, such as MRI, X-ray and electromyography, for oyster shuckers and other fishery occupations, and objectively proved that the burden on the hands of oyster shuckers was high.

CONCLUSIONS

In oyster shuckers, the incidence of hand and wrist OA was 84%, that of CTS was 72%, and that of ulnar impaction syndrome was 41%. In addition, oyster shuckers were more likely to be exposed to occupational burden factors than were other types of fishermen. Therefore, the authors think that proper stretching or exercise for rest and musculoskeletal relaxation, as well as health-care education and promotion, will be needed for the fishermen's repeated posture and impact work.

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